

Environmental controls on alternating aragonite-calcite laminations in notch-speleothems from Cayman Brac, Cayman Islands, British West Indies

E. Zheng^a and B. Jones^a

^a *Earth and Atmospheric Sciences, University of Alberta, AB, Canada*

Speleothems that grow in semi-exposed surface environments, such as wave-cut notches and cave entrances, are not well understood despite their widespread distribution. These surface environments are characterized by low atmospheric CO₂ concentrations and variable temperature and humidity levels. On Cayman Brac, there is a well-developed wave-cut notch, 6.4 m above sea-level, that formed ~ 125,000 years ago during Marine Isotope Stage (MIS) 5e. The wave-cut notch is decorated with stalactites, stalagmites and columns (up to 1 m high and 1 m in diameter) that have contorted surfaces. U/Th dating of the speleothems indicates that they formed 46,000 to 49,000 years ago. The speleothems are formed by calcite, aragonite, and mixed calcite-aragonite laminae, typically ~0.1 to ~1mm thick, that are separated by conformable and unconformable lamination boundaries that are typically highlighted by dark-coloured micrite and/or microbial mats. The mineralogy, crystal morphologies, and fabrics vary between laminations in the same speleothem and from speleothem to speleothem. Some calcite crystals encase aragonite needles whereas others contain ghost structures of the aragonite crystals. The $\delta^{18}\text{O}$ values range of the calcite and aragonite ranges from -6.5 to +0.3‰ VPDB, and the $\delta^{13}\text{C}$ values vary between -11.4 to +1.9‰ VPDB. The positive linear regression between the $\delta^{18}\text{O}$ values and the $\delta^{13}\text{C}$ values indicates that the evaporation and/or kinetic isotope effects aside from temperatures control. The $\delta^{18}\text{O}$ and $\delta^{13}\text{C}$ values increase as the aragonite content increases. These results suggest that the aragonite laminae formed under relatively dry conditions whereas the calcite laminae formed during wet periods. The temporal and spatial relationships between aragonite and calcite indicate that formation of the Cayman aragonite-calcite speleothems was related to paleo rainfall amount, paleotemperature, and other ambient environmental factors.

Corresponding author: erjun@ualberta.ca